

APPENDIX A

AMS-02 GROUND PAYLOAD HAZARD REPORTS

PAYLOAD HAZARD REPORT		a. NO: G-AMS-02-1
b. PAYLOAD: Alpha Magnetic Spectrometer-02 (AMS-02)		c. PHASE: 0/I
d. SUBSYSTEM: Structures	e. HAZARD GROUP: Collision, Injury	f. DATE: February 2002
g. HAZARD TITLE: Failure of the AMS-02 Lifting Equipment		i. HAZARD CATEGORY <input checked="" type="checkbox"/> CATASTROPHIC <input type="checkbox"/> CRITICAL
h. APPLICABLE SAFETY REQUIREMENTS: KHB 1700.7C, Sections: 4.1.3 Hazardous Operations, 4.2.1 Human Factors, 4.5.1 Hoisting and Handling		
j. DESCRIPTION OF HAZARD: Structural failure or inadvertent separation of the AMS-02 lifting equipment [Primary Support Stand (PSS), Primary Lifting Fixture (PLF), Multi Purpose Lifting Fixture (MPLF), Lower Unique Support Structure-02 (USS-02) Support Fixture, Lower USS-02 eyebolts, Lower USS-02 shipping cover eyebolts and the Ground Support Equipment (GSE) Dewar and Pump Lifting Sling] could result in injury to personnel and/or damage to STS/ISS equipment, payloads, ground support equipment and/or facilities. Note: The eyebolts on the Lower USS-02 and the Lower USS-02 Shipping Cover are not permanently attached.		
k. HAZARD CAUSES: <ol style="list-style-type: none"> 1. Inadequate structural design of the AMS-02 lifting equipment. 2. Propagation of flaws or crack-like defects in the AMS-02 lifting equipment. 3. Improper attachment of the AMS-02 swivel hoist rings. 4. Structural deterioration of the AMS-02 lifting equipment due to use or aging. 5. Overload of the AMS-02 lifting equipment. 6. Improper assembly of the AMS-02 lifting equipment. 7. Personnel error. 		
l. HAZARD CONTROLS: (See Continuation Sheet 1)		
m. SAFETY VERIFICATION METHODS: (See Continuation Sheet 2)		
n. STATUS OF VERIFICATION: (See Continuation Sheet 2)		
o. APPROVAL	PAYLOAD ORGANIZATION	SSP/ISS
PHASE I	ORIGINAL SIGNED BY JAMES R. BATES ON 2/12/02	ORIGINAL SIGNED BY JOHN C. DOLLBERG ON 3/27/02
PHASE II		
PHASE III		

PAYLOAD HAZARD REPORT CONTINUATION SHEET 1	a. NO: G-AMS-02-1
b. PAYLOAD: Alpha Magnetic Spectrometer-02 (AMS-02)	c. PHASE: 0/I
<p>I. HAZARD CONTROLS:</p> <ol style="list-style-type: none"> 1.a. The AMS-02 lifting equipment is being designed to a safety factor of 5:1 against ultimate for all crane lifting operations. For forklift operations, the Lower USS-02 Support Fixture is being designed to a safety factor of 3:1 against yield. For dolly towing (5 mph), the PSS is being designed to a safety factor of 2:1 against yield and 3:1 against ultimate. (See attached AMS-02 Ground Support Lifting/Handling Equipment Matrix) 1.b. Proof tests will be performed on the AMS-02 lifting equipment. 2. Nondestructive Inspection (NDI) will be performed on AMS-02 shackles, swivel hoist rings, master link assemblies and removable eyebolts after the initial proof tests for crack/defect detection. 3. Torque values and visual inspections for AMS-02 swivel hoist rings and removable eyebolts will be specified on AMS-02 drawings to assure full thread engagement after mounting. 4. The AMS-02 lifting equipment will be visually inspected each day prior to use and structural inspections will be performed per KHB 1700.7C, Section 4.5.1.2.d, at least annually. 5. The AMS-02 lifting equipment will be posted with the equipment identification, next required test date, quality control stamp, rated load, proof load and proof load date. 6.a. Part numbers for components of the AMS-02 lifting equipment which will normally be disassembled will be specified on drawings and in procedures to assure proper reassembly. 6.b. Approved drawings and procedures will be used for reassembly of the AMS-02 lifting equipment. 7. Only certified personnel will use the AMS-02 lifting equipment and perform the lifting operations. <p>(See Continuation Sheet 2)</p>	

PAYLOAD HAZARD REPORT CONTINUATION SHEET 2	a. NO: G-AMS-02-1
b. PAYLOAD: Alpha Magnetic Spectrometer-02 (AMS-02)	c. PHASE: 0/I
m. SAFETY VERIFICATION METHODS: 1.a. Stress analyses will be performed to verify the proper safety factors were used. 1.b. Review of proof test reports. 2. Review of NDI reports. 3. Review of AMS-02 drawings. 4. Review of AMS-02 procedures and inspection reports. 5. QA inspections/verifications that the AMS-02 lifting equipment is properly posted/tagged. 6.a. Review of AMS-02 drawings and procedures for the AMS-02 lifting equipment. 6.b. Review of AMS-02 procedures for reassembly instructions and QA inspections/verifications of proper reassembly. 7. Review of personnel certification documentation.	
n. STATUS OF VERIFICATION: 1.a, 1.b & 2. Open; See attached AMS-02 Ground Support Lifting/Handling Equipment Matrix for status. 3. Open 4. Open 5. Open 6.a. Open 6.b. Open 7. Open	

AMS-02 Ground Support Lifting/Handling Equipment Matrix

Date: 12/19/01

Designation Number	Item Name	Sling		Critical Welds		Actual Load (lbs.)	Rated Load (lbs.)	Proof Load (lbs.)	Design Load (lbs.)		Verification Status
		Met	Syn	Yes	No				Ult	Yield	
SEG38117000	Primary Support Stand (being lifted by Primary Lifting Fixture with AMS-02 payload)				X	20,900	TBD	2 x TBD	5 x TBD	—	Stress analysis, proof load test and NDI - Open.
SEG38117000	Primary Support Stand (dolly towing - 5 mph)				X	20,900	21,527	N/A	64,581	59,356*	Stress analysis - Open.
SEG38117112	Primary Lifting Fixture (lifting Primary Support Stand with AMS-02 payload)	X			X	24,900	25,647	51,294	128,235	—	Stress analysis, proof load test and NDI - Open.
SEG38117112	Primary Lifting Fixture (sliding Primary Support Stand vertical corner supports to low, medium & high positions)	X			X	15,839	22,808	45,616	114,040	—	Stress analysis, proof load test and NDI - Open.
SEG38117050	Multi Purpose Lifting Fixture (lifting Lower USS-02 Support Fixture)	X			X	11,142	14,150	28,300	70,750	—	Stress analysis, proof load test and NDI - Open.
SED38116930	Lower USS-02 Support Fixture (being lifted by Multi Purpose Lifting Fixture)				X	4,136	8,148	16,296	40,740	—	Stress analysis, proof load test and NDI - Open.
SED38116930	Lower USS-02 Support Fixture (being lifted by forklift)				X	4,136	7,403	N/A	—	22,209	Stress analysis - Open.
TBD	Lower USS-02 Eyebolts (1 of 4)**				X	TBD	TBD	TBD	TBD	TBD	Stress analysis, proof load test and NDI - Open.
TBD	Lower USS-02 Shipping Cover Eyebolts (1 of 4)**				X	TBD	TBD	TBD	TBD	TBD	Stress analysis, proof load test and NDI - Open.
TBD	GSE Dewar and Pump Lifting Sling					TBD	TBD	2 x TBD	5 x TBD	—	Stress analysis, proof load test and NDI - Open.

*Rated load for yield is 29,678 lbs. Design load yield = 29,678 lbs. x 2.0 = 59,356 lbs.

**Not permanently fixed to load.

PAYLOAD HAZARD REPORT		a. NO: G-AMS-02-2
b. PAYLOAD: Alpha Magnetic Spectrometer-02 (AMS-02)		c. PHASE: 0/I
d. SUBSYSTEM: Structures	e. HAZARD GROUP: Collision, Injury	f. DATE: February 2002
g. HAZARD TITLE: Structural Failure of the AMS-02 Primary Support Stand (PSS) During Static Operations		i. HAZARD CATEGORY <input checked="" type="checkbox"/> CATASTROPHIC <input type="checkbox"/> CRITICAL
h. APPLICABLE SAFETY REQUIREMENTS: KHB 1700.7C, Section: 4.5.1.6 Stands		
j. DESCRIPTION OF HAZARD: Structural failure of the PSS while it is being used as a support/work stand could result in injury to personnel and/or damage to the AMS-02 payload or ground support equipment.		
k. HAZARD CAUSES: 1. Inadequate structural design. 2. Improper assembly/adjustment of the PSS vertical corner supports.		
l. HAZARD CONTROLS: 1. The PSS is being designed to a safety factor of 3:1 against yield. However, the base of the PSS is being designed to a safety factor of 4:1 against ultimate because it will support personnel. [See attached AMS-02 Ground Support Equipment Stand (Static) Matrix] 2. The part numbers and torque values for the bolts used to adjust the vertical corner supports of the PSS will be specified in the adjustment procedure.		
m. SAFETY VERIFICATION METHODS: 1. Stress analyses will be performed for the PSS to verify the proper factors of safety were used. 2. Review of the PSS adjustment procedure.		
n. STATUS OF VERIFICATION: 1. Open 2. Open		
o. APPROVAL	PAYLOAD ORGANIZATION	SSP/ISS
PHASE I	ORIGINAL SIGNED BY JAMES R. BATES ON 2/12/02	ORIGINAL SIGNED BY JOHN C. DOLLBERG ON 3/27/02
PHASE II		
PHASE III		

AMS-02 Ground Support Equipment Stand (Static) Matrix

Date: 12/19/01

Designation Number	Item Name	Sling		Critical Welds		Actual Load (lbs.)	Rated Load (lbs.)	Proof Load (lbs.)	Design Load (lbs.)		Verification Status
		Met	Syn	Yes	No				Ult	Yield	
SEG38117000	Primary Support Stand (PSS) (static assembly and integration stand)				X	20,900	51,414	N/A	205,656*	154,242	Stress analysis - Open.

*Base of PSS is designed to safety factor of 4:1 against ultimate because it will support personnel.

PAYLOAD HAZARD REPORT		a. NO: G-AMS-02-3
b. PAYLOAD: Alpha Magnetic Spectrometer-02 (AMS-02)		c. PHASE: 0/I
d. SUBSYSTEM: Radiation	e. HAZARD GROUP: Radiation	f. DATE: February 2002
g. HAZARD TITLE: AMS-02 Magnetic Field Causes Personnel Injury/Equipment Interference		i. HAZARD CATEGORY <input type="checkbox"/> CATASTROPHIC <input checked="" type="checkbox"/> CRITICAL
h. APPLICABLE SAFETY REQUIREMENTS: KHB 1700.7C, Section: 4.3.4 Radiation; and the American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices, dated 1995-1996.		
j. DESCRIPTION OF HAZARD: Injury to personnel and/or interference with GSE or other payloads because of exposure to an excessive AMS-02 magnetic field.		
k. HAZARD CAUSES: The AMS-02 cryogenic superconducting magnet (cryomag) generates a magnetic field which might cause personnel injury and/or interference with GSE or other payloads being processed in the same area, if it exceeds the levels defined in the ACGIH Biological Exposure Indices for magnetic fields.		
l. HAZARD CONTROLS: 1. The AMS-02 cryomag is being designed to reduce the magnetic field outside the magnet as much as possible. This has been done by careful arrangement of the racetrack and dipole coils to create a large magnetic field inside and a greatly reduced field on the outside. If the AMS-02 cryomag does not comply with the requirements of the ACGIH Biological Exposure Indices for magnetic fields, a keep-out zone may be required. (See Continuation Sheet 1)		
m. SAFETY VERIFICATION METHODS: (See Continuation Sheet 1)		
n. STATUS OF VERIFICATION: (See Continuation Sheet 1)		
o. APPROVAL	PAYLOAD ORGANIZATION	SSP/ISS
PHASE I	ORIGINAL SIGNED BY JAMES R. BATES ON 2/12/02	ORIGINAL SIGNED BY JOHN C. DOLLBERG ON 3/27/02
PHASE II		
PHASE III		

PAYLOAD HAZARD REPORT CONTINUATION SHEET 1		a. NO: G-AMS-02-3
b. PAYLOAD: Alpha Magnetic Spectrometer-02 (AMS-02)		c. PHASE: 0/I
l. HAZARD CONTROLS: 2. Warning signs will be posted at control entry points (including on the PGHM at the pad) for pacemaker wearers.		
m. SAFETY VERIFICATION METHODS: 1. Measurements and mapping of the AMS-02 external magnetic field will be performed to verify compliance with the requirements. The measurements and mapping will be submitted to the KSC Health Physics Office for approval. The KSC Health Physics Office will perform a baseline magnetic field survey as soon as operationally possible after the magnet arrives at KSC. 2. Verification will be by requirements in the procedures to inspect for warning signs.		
n. STATUS OF VERIFICATION: 1. Open 2. Open		

PAYLOAD HAZARD REPORT		a. NO: G-AMS-02-4
b. PAYLOAD: Alpha Magnetic Spectrometer-02 (AMS-02)		c. PHASE: 0/I
d. SUBSYSTEM: Materials	e. HAZARD GROUP: Fire/Injury and Illness	f. DATE: February 2002
g. HAZARD TITLE: Improper Materials Usage Causes Fire/Personnel Injury		i. HAZARD CATEGORY <input type="checkbox"/> CATASTROPHIC <input checked="" type="checkbox"/> CRITICAL
h. APPLICABLE SAFETY REQUIREMENTS: KHB 1700.7C, Sections: 4.3.9 GSE Materials		
j. DESCRIPTION OF HAZARD: AMS-02 GSE materials which are flammable, static-producing or toxic could cause a fire/personnel injury.		
k. HAZARD CAUSES: Use of flammable materials, static-producing materials or toxic cleaning solvents/adhesives which pose a hazard in KSC payload processing areas.		
l. HAZARD CONTROLS: 1. Use of flammable AMS-02 GSE materials will be avoided wherever possible in all payload processing areas. A list of any flammable materials used will be submitted to the Customer Integration Manager (CIM). 2. All plastic films, adhesive tape and foams used will be from the NASA/KSC approved lists. 3. KSC-provided cleaning solvents and adhesives will be used when possible. Cleaning solvents and adhesives not provided by KSC will be submitted to the CIM.		
m. SAFETY VERIFICATION METHODS: 1, 2 & 3. Review of AMS-02 GSE materials lists and review of AMS-02 procedures for location of materials usage. Material Safety Data Sheets (MSDS's) will be submitted to the CIM for all materials not on the NASA/KSC approved lists.		
n. STATUS OF VERIFICATION: 1, 2 & 3. Open		
o. APPROVAL	PAYLOAD ORGANIZATION	SSP/ISS
PHASE I	ORIGINAL SIGNED BY JAMES R. BATES ON 2/12/02	ORIGINAL SIGNED BY JOHN C. DOLLBERG ON 3/27/02
PHASE II		
PHASE III		

PAYLOAD HAZARD REPORT		a. NO: G-AMS-02-5
b. PAYLOAD: Alpha Magnetic Spectrometer-02 (AMS-02)		c. PHASE: 0/I
d. SUBSYSTEM: Human Factors	e. HAZARD GROUP: Injury	f. DATE: February 2002
g. HAZARD TITLE: Contact with Sharp Edges, Corners or Protrusions Causes Personnel Injury		i. HAZARD CATEGORY <input type="checkbox"/> CATASTROPHIC <input checked="" type="checkbox"/> CRITICAL
h. APPLICABLE SAFETY REQUIREMENTS: KHB 1700.7C, Sections: 4.2.1 Human Factors, 4.2.1.4.a. Physical, and MIL-STD-1472F		
j. DESCRIPTION OF HAZARD: Personnel could be injured by handling AMS-02 GHE/GSE if it has exposed sharp edges, corners or protrusions.		
k. HAZARD CAUSES: Exposed sharp edges, corners or protrusions on AMS-02 GHE/GSE as a result of the design or manufacturing.		
l. HAZARD CONTROLS: The radii of exposed sharp edges, corners and protrusions will meet the requirements of MIL-STD-1472F and section 4.2.1.4.a. "Physical", of KHB 1700.7C.		
m. SAFETY VERIFICATION METHODS: Sharp edge inspections of exposed edges, corners and protrusions will be performed on the AMS-02 GHE and GSE.		
n. STATUS OF VERIFICATION: Open		
o. APPROVAL	PAYLOAD ORGANIZATION	SSP/ISS
PHASE I	ORIGINAL SIGNED BY JAMES R. BATES ON 2/12/02	ORIGINAL SIGNED BY JOHN C. DOLLBERG ON 3/27/02
PHASE II		
PHASE III		

PAYLOAD HAZARD REPORT		a. NO: G-AMS-02-6
b. PAYLOAD: Alpha Magnetic Spectrometer-02 (AMS-02)		c. PHASE: 0/I
d. SUBSYSTEM: Electrical	e. HAZARD GROUP: Electrical	f. DATE: February 2002
g. HAZARD TITLE: Electrical Damage to the Orbiter, ISS Equipment, KSC Facilities, AMS-02 Payload or GSE.		i. HAZARD CATEGORY <input type="checkbox"/> CATASTROPHIC <input checked="" type="checkbox"/> CRITICAL
h. APPLICABLE SAFETY REQUIREMENTS: KHB 1700.7C, Section: 4.3.2 Electrical		
j. DESCRIPTION OF HAZARD: AMS-02 electrical GSE malfunctions or connection errors could cause damage to the Orbiter, ISS equipment, KSC facilities, AMS-02 flight hardware or other GSE.		
k. HAZARD CAUSES: 1. AMS-02 electrical GSE malfunctions which induce overload into the electrical circuitry of the Orbiter, ISS equipment, KSC facilities, AMS-02 flight hardware or other GSE. 2. Mismatching of AMS-02 connectors. 3. Mismatch of three-phase power sequencing between the AMS-02 electrical GSE and the KSC facilities.		
l. HAZARD CONTROLS: 1. AMS-02 GSE electrical circuits will be designed with overload protection devices, such as fuses and circuit breakers. 2. AMS-02 connectors will be selected which make it physically impossible to mismatch, if mismatching could cause damage to the Orbiter, ISS equipment, KSC facilities, AMS-02 flight hardware or other GSE. (See Continuation Sheet 1)		
m. SAFETY VERIFICATION METHODS: (See Continuation Sheet 1)		
n. STATUS OF VERIFICATION: (See Continuation Sheet 1)		
o. APPROVAL	PAYLOAD ORGANIZATION	SSP/ISS
PHASE I	ORIGINAL SIGNED BY JAMES R. BATES ON 2/12/02	ORIGINAL SIGNED BY JOHN C. DOLLBERG ON 3/27/02
PHASE II		
PHASE III		

PAYLOAD HAZARD REPORT CONTINUATION SHEET 1		a. NO: G-AMS-02-6
b. PAYLOAD: Alpha Magnetic Spectrometer-02 (AMS-02)		c. PHASE: 0/I
i. HAZARD CONTROLS: 3. Three-phase power sequencing will be verified in each KSC facility prior to connecting any AMS-02 EGSE which requires three-phase power.		
m. SAFETY VERIFICATION METHODS: 1. Review of AMS-02 electrical GSE to verify GSE meets the requirements of KHB 1700.7C, Section 4.3.2 "Electrical" and the "National Electric Code (NEC), National Fire Protection Association 70 (NFPA 70)" or equivalent. (Preliminary matrices of AMS-02 electrical GSE are attached.) 2. Review of AMS-02 drawings and QA inspections of as-built hardware to approved drawings. 3. Review of AMS-02 procedures for verification of three-phase power sequencing in each KSC facility prior to connecting any AMS-02 EGSE which requires three-phase power.		
n. STATUS OF VERIFICATION: 1. Open 2. Open 3. Open		

AMS-02 Cryomag Electrical GSE Matrix

Item	Quantity	Manufacturer	Model No.	Commercial (Yes/No)	Electrical Code	Power Requirement	3-Phase (Yes/No)	KSC Facilities	Batteries (Yes/No)
Superfluid He Pump Cart	3	TBD	TBD	Yes	*	440V / 40A 220V / 60A	Yes	MPPF/SSPF/PCR	No
He Leak Detector	1	TBD	TBD	Yes	*	120V / 20A	No	MPPF/SSPF/PCR	No
Turbomolecular Vacuum Pump/Cart ⁽¹⁾	1-2	TBD	TBD	Yes	*	220V / 30A	Yes	MPPF/SSPF/PCR	No
Electronics Support Cart:	2					120V / 20A	No	MPPF/SSPF/PCR	
Personal Computer	1 per cart	Intel	TBD	Yes	*		No	MPPF/SSPF/PCR	Yes
DC Power Supply	1 per cart	TBD	TBD	Yes	*		No	MPPF/SSPF/PCR	No
UPS	1 per cart	TBD	TBD	Yes	*		No	MPPF/SSPF/PCR	Yes
Signal/Power Control Panel	1 per cart	TBD	TBD	Yes	*		No	MPPF/SSPF/PCR	No
Cryo Servicing Rack:	2					120V / 15A	No	MPPF/SSPF/PCR	
Personal Computer	1 per rack	Intel	TBD	Yes	*		No	MPPF/SSPF/PCR	Yes
DC Power Supply	1 per rack	TBD	TBD	Yes	*		No	MPPF/SSPF/PCR	No
UPS	1 per rack	TBD	TBD	Yes	*		No	MPPF/SSPF/PCR	Yes
Signal/Power Control Panel	1 per rack	TBD	TBD	Yes	*		No	MPPF/SSPF/PCR	No
Cryo Handling Units	TBD	TBD	TBD	No	*	TBD	No	MPPF/SSPF/PCR	No

* UL approved or equivalent.

NOTE: (1) Contingency use only.

AMS-02 Experiment Electrical GSE Matrix

Item	Quantity	Manufacturer	Model No.	Commercial (Yes/No)	Electrical Code	Power Requirement	3-Phase (Yes/No)	KSC Facilities	Batteries (Yes/No)
Front End Computers:									
Dual-CPU PCs	6	Intel or AMD	TBD	Yes	*	TBD	No	MPPF/SSPF	Yes
Data Processing Farm:									
Dual-CPU PCs	20	Intel or AMD	TBD	Yes	*	TBD	No	MPPF/SSPF	Yes
CPU Patch Panel Switches	3	TBD	TBD	Yes	*	TBD	No	MPPF/SSPF	No
UPSs	7	TBD	TBD	Yes	*	TBD	No	MPPF/SSPF	Yes
Ethernet Switches/Hubs	5	TBD	TBD	Yes	*	TBD	No	MPPF/SSPF	No
Misc. Cables	TBD	TBD	TBD	Yes	*	TBD	No	MPPF/SSPF	No
17" Monitors	3	TBD	TBD	Yes	*	TBD	No	MPPF/SSPF	No
Data Servers/Archiving Tapes:									
Dual-CPU PCs	5	Intel or AMD	TBD	Yes	*	TBD	No	MPPF/SSPF	Yes
External SCSI Disk Towers	5	TBD	TBD	Yes	*	TBD	No	MPPF/SSPF	No
SuperDLT or LTO Tape Drives	3	TBD	TBD	Yes	*	TBD	No	MPPF/SSPF	No
UPSs	4	TBD	TBD	Yes	*	TBD	No	MPPF/SSPF	Yes
Ethernet Switches	2	TBD	TBD	Yes	*	TBD	No	MPPF/SSPF	No
Analysis Computing Facilities:									
SMT Computers	2-3	Sun or Compaq	TBD	Yes	*	TBD	No	MPPF/SSPF	Yes
Attached RAID Arrays	1-2	TBD	TBD	Yes	*	TBD	No	MPPF/SSPF	No
UPSs	2	TBD	TBD	Yes	*	TBD	No	MPPF/SSPF	No
17" Monitors	3	TBD	TBD	Yes	*	TBD	No	MPPF/SSPF	No
Mouses/Cables/Keyboards	TBD	TBD	TBD	Yes	*	TBD	No	MPPF/SSPF	No
Desktop Computers:									
PCs (w/monitor & keyboard)	30-40	Intel or AMD	TBD	Yes	*	TBD	No	MPPF/SSPF	Yes
Printers:									
Laserjet Printers	5	Hewlett Packard	TBD	Yes	*	TBD	No	MPPF/SSPF	No

* UL approved or equivalent.

PAYLOAD HAZARD REPORT		a. NO: G-AMS-02-7
b. PAYLOAD: Alpha Magnetic Spectrometer-02 (AMS-02)		c. PHASE: 0/I
d. SUBSYSTEM: Electrical	e. HAZARD GROUP: Electrical Shock	f. DATE: February 2002
g. HAZARD TITLE: Electrical Shock Causes Personnel Injury		i. HAZARD CATEGORY <input checked="" type="checkbox"/> CATASTROPHIC <input type="checkbox"/> CRITICAL
h. APPLICABLE SAFETY REQUIREMENTS: KHB 1700.7C, Section: 4.3.2 Electrical		
j. DESCRIPTION OF HAZARD: Personnel coming in contact with hazardous voltages in the AMS-02 payload or GSE could receive an electrical shock resulting in injury or death.		
k. HAZARD CAUSES: 1. AMS-02 voltages in excess of 30 VAC (rms) or 50 VDC which are accessible to personnel. 2. AMS-02 payload or electrical GSE conductive external parts or surfaces that are not at ground potential. 3. Personnel short an energized AMS-02 payload or GSE electrical circuit during connector mating/demating. 4. Mismatching of AMS-02 connectors.		
l. HAZARD CONTROLS: (See Continuation Sheet 1)		
m. SAFETY VERIFICATION METHODS: (See Continuation Sheet 1)		
n. STATUS OF VERIFICATION: (See Continuation Sheet 1)		
o. APPROVAL	PAYLOAD ORGANIZATION	SSP/ISS
PHASE I	ORIGINAL SIGNED BY JAMES R. BATES ON 2/12/02	ORIGINAL SIGNED BY JOHN C. DOLLBERG ON 3/27/02
PHASE II		
PHASE III		

PAYLOAD HAZARD REPORT CONTINUATION SHEET 1	a. NO: G-AMS-02-7
b. PAYLOAD: Alpha Magnetic Spectrometer-02 (AMS-02)	c. PHASE: 0/I
<p>i. HAZARD CONTROLS:</p> <ol style="list-style-type: none"> 1. AMS-02 voltages in excess of 30 VAC (rms) or 50 VDC will be enclosed or otherwise protected from personnel contact. 2.a. Proper grounding and bonding between AMS-02 hardware and KSC facilities will be used. The design, construction and installation of the AMS-02 payload and electrical GSE will assure that all conductive external parts and surfaces are at ground potential at all times. 2.b. AMS-02 GSE power cords will have a non-current carrying ground conductor. 3. All mating/demating of connectors will be performed on de-energized electrical circuits. 4. AMS-02 connectors will be selected which make it physically impossible to mismatch, if mismatching could cause an electrical shock hazard. 	
<p>m. SAFETY VERIFICATION METHODS:</p> <ol style="list-style-type: none"> 1. Review of electrical drawings/equipment to verify the AMS-02 payload and GSE meet the requirements of KHB 1700.7C, Section 4.3.2 "Electrical" and the "National Electric Code (NEC), National Fire Protection Association 70 (NFPA 70)" or equivalent. 2.a. Grounding and bonding verification tests will be performed on the AMS-02 payload, electrical GSE and the interfacing between AMS-02 equipment and KSC facilities. 2.b. QA inspections/verification tests of the AMS-02 hardware. 3. Review of AMS-02 procedures. 4. Review of AMS-02 drawings and QA inspections of as-built hardware to approved drawings. 	
<p>n. STATUS OF VERIFICATION:</p> <ol style="list-style-type: none"> 1. Open 2.a. Open 2.b. Open 3. Open 4. Open 	

PAYLOAD HAZARD REPORT		a. NO: G-AMS-02-8
b. PAYLOAD: Alpha Magnetic Spectrometer-02 (AMS-02)		c. PHASE: 0/I
d. SUBSYSTEM: Electrical	e. HAZARD GROUP: Fire	f. DATE: February 2002
g. HAZARD TITLE: Electrical Ignition Sources Cause Fire		i. HAZARD CATEGORY <input type="checkbox"/> CATASTROPHIC <input checked="" type="checkbox"/> CRITICAL
h. APPLICABLE SAFETY REQUIREMENTS: KHB 1700.7C, Section: 4.3.2 Electrical		
j. DESCRIPTION OF HAZARD: Electrical ignition sources in the AMS-02 electrical GSE could cause a fire and result in injury and/or equipment/facility damage.		
k. HAZARD CAUSES: 1. AMS-02 GSE electrical circuits overheat due to overloads or short circuits. 2. Mating/demating of energized AMS-02 electrical circuits causing arcing. 3. Mismatching of AMS-02 connectors. 4. Runaway AMS-02 heaters.		
l. HAZARD CONTROLS: 1. AMS-02 GSE electrical circuits are being designed using proper wire sizes and overload protection devices (such as fuses and circuit breakers) to prevent overheating. 2. All mating/demating of connectors will be performed on de-energized electrical circuits. (See Continuation Sheet 1)		
m. SAFETY VERIFICATION METHODS: (See Continuation Sheet 1)		
n. STATUS OF VERIFICATION: (See Continuation Sheet 1)		
o. APPROVAL	PAYLOAD ORGANIZATION	SSP/ISS
PHASE I	ORIGINAL SIGNED BY JAMES R. BATES ON 2/12/02	ORIGINAL SIGNED BY JOHN C. DOLLBERG ON 3/27/02
PHASE II		
PHASE III		

PAYLOAD HAZARD REPORT CONTINUATION SHEET 1		a. NO: G-AMS-02-8
b. PAYLOAD: Alpha Magnetic Spectrometer-02 (AMS-02)		c. PHASE: 0/I
l. HAZARD CONTROLS: 3. AMS-02 connectors will be selected which make it physically impossible to mismatch, if an ignition source could be created. 4. The AMS-02 heater circuits will be monitored and kept below a temperature of TBD.		
m. SAFETY VERIFICATION METHODS: 1. Review of AMS-02 electrical GSE to verify GSE meets the requirements of KHB 1700.7C, Section 4.3.2 "Electrical" and the "National Electric Code (NEC), National Fire Protection Association 70 (NFPA 70)" or equivalent. 2. Review of AMS-02 procedures. 3. Review of AMS-02 drawings and QA inspections of as-built hardware to approved drawings. 4. Review of AMS-02 procedures to verify monitoring of heater circuit temperatures.		
n. STATUS OF VERIFICATION: 1. Open 2. Open 3. Open 4. Open		

PAYLOAD HAZARD REPORT		a. NO: G-AMS-02-9
b. PAYLOAD: Alpha Magnetic Spectrometer-02 (AMS-02)		c. PHASE: 0/I
d. SUBSYSTEM: Environmental Control	e. HAZARD GROUP: Temperature Extremes	f. DATE: March 2002
g. HAZARD TITLE: Contact with High Temperature Surfaces Causes Personnel Injury		i. HAZARD CATEGORY <input type="checkbox"/> CATASTROPHIC <input checked="" type="checkbox"/> CRITICAL
h. APPLICABLE SAFETY REQUIREMENTS: KHB 1700.7C, Section: 4.2.1.5 Temperature		
j. DESCRIPTION OF HAZARD: AMS-02 exposed surface temperatures which exceed 113°F (45°C) could cause burn injuries to personnel.		
k. HAZARD CAUSES: Personnel coming in contact with AMS-02 exposed surfaces [which exceed 113°F (45°C)] heated by AMS-02 rectifiers or heaters.		
l. HAZARD CONTROLS: The AMS-02 payload will be roped off to prevent contact by personnel during electrical operations of the AMS-02 rectifiers or powering of the AMS-02 heaters. (Access will only be allowed for temperature measurements or repairs solely by personnel acquainted with the locations of the rectifiers and heaters.)		
m. SAFETY VERIFICATION METHODS: AMS-02 procedures will specify roping off the AMS-02 payload during operation of the rectifiers or heaters, and only allow access as identified above.		
n. STATUS OF VERIFICATION: Open		
o. APPROVAL	PAYLOAD ORGANIZATION	SSP/ISS
PHASE I	ORIGINAL SIGNED BY JAMES R. BATES ON 3/22/02	ORIGINAL SIGNED BY JOHN C. DOLLBERG ON 3/27/02
PHASE II		
PHASE III		

PAYLOAD HAZARD REPORT		a. NO: G-AMS-02-10
b. PAYLOAD: Alpha Magnetic Spectrometer-02 (AMS-02)		c. PHASE: 0/I
d. SUBSYSTEM: Pressure	e. HAZARD GROUP: Explosion, Collision, Injury, Temperature Extremes	f. DATE: February 2002
g. HAZARD TITLE: Rupture of the 1000 Liter GSE Liquid Helium (LHe) Supply Dewar(s), the Transition Radiation Detector (TRD) GSE Pressure System(s) and/or the Flight Dewar		i. HAZARD CATEGORY <input checked="" type="checkbox"/> CATASTROPHIC <input type="checkbox"/> CRITICAL
h. APPLICABLE SAFETY REQUIREMENTS: KHB 1700.7C, Sections: 4.3.3 Pressure/Vacuum Systems and 4.3.8 Cryogenics		
j. DESCRIPTION OF HAZARD: Operator error, handling error or structural failure causes the 1000 liter GSE LHe supply dewar(s), the TRD GSE pressure system(s) and/or the flight dewar to rupture, causing a hazard to personnel and possible damage to STS/ISS equipment, payloads, GSE and/or KSC facilities.		
k. HAZARD CAUSES: 1. Structural failure of GSE pressure vessel(s) or outer shell of LHe supply dewar(s). 2. Puncture of the flight dewar vacuum case with the Orbiter payload bay doors open, during online/offline ground processing. 3. Puncture of the flight dewar vacuum case with the Orbiter payload bay doors closed. 4. Improper handling or operator error during operation, transportation, lifting or securing. 5. Blockage of vent line due to frozen impurities in He liquid or gas		
l. HAZARD CONTROLS: (See Continuation Sheet 1)		
m. SAFETY VERIFICATION METHODS: (See Continuation Sheet 2)		
n. STATUS OF VERIFICATION: (See Continuation Sheet 3)		
o. APPROVAL	PAYLOAD ORGANIZATION	SSP/ISS
PHASE I	ORIGINAL SIGNED BY JAMES R. BATES ON 2/12/02	ORIGINAL SIGNED BY JOHN C. DOLLBERG ON 3/27/02
PHASE II		
PHASE III		

PAYLOAD HAZARD REPORT CONTINUATION SHEET 1	a. NO: G-AMS-02-10
b. PAYLOAD: Alpha Magnetic Spectrometer-02 (AMS-02)	c. PHASE: 0/I
I. HAZARD CONTROLS: <p>1.a. LHe supply dewars are being designed to withstand 60 psig in the inner tank and 30 psig in the outer shell without burst and the inner tank will be tested to 45 psid (MAWP=25 psid inner tank; 3-5 psig outer shell). (GSE LHe Dewars' Pressure System Components Matrix is TBS.)</p> <p>1.b. GSE LHe supply dewar internal pressures will be limited to 10 psig \pm 5% through the use of redundant relief valves (4) set at 10 psig \pm 5% and through use of approved procedures. (Note: Relief pressure on the outer shell will be limited to 3-5 psig \pm 5% by a pressure relief valve and pump-out port.)</p> <p>1.c. The TRD GSE pressure systems are being designed to have a design burst pressure of 4 x MOP. (See attached TRD Ground Support Pressure Systems Component Matrix)</p> <p>2.a. The flight dewar system incorporates burst disks so that the pressure will not exceed the Maximum Design Pressure (MDP) of the system. (See attached Cryogenic Schematic)</p> <p>2.b. Emergency vent lines will be used. They will be plumbed away from ground personnel and directed out of the work area by proper GSE set-up design. Vent shields and deflectors might be used, and the emergency vent lines may have to be vented outside of KSC facilities to avoid oxygen deprivation (See Hazard Report# G-AMS-02-13). (NOTE: The emergency vent lines will be removed just prior to closing the Orbiter payload bay doors.)</p> <p>3. The flight dewar vacuum case has been designed to preclude puncture by an object falling on it in the Orbiter payload bay with the doors closed.</p> <p>4.a. Approved procedures will be used for operating, transporting, lifting and securing the GSE dewars, the TRD GSE pressure systems and the flight dewar.</p> <p>4.b. Handling personnel will be trained regarding the hazards associated with LHe handling operations and the TRD GSE pressure systems.</p> <p>4.c. Access will be restricted to allow qualified personnel only.</p> <p>5.a. Helium pressurant will meet the purity standards of MIL-P-27407A.</p> <p>5.b. Adequate redundancy for pressure relief will be provided.</p> <p>5.c. LHe will be filtered to remove particles > 2 microns before filling GSE supply dewars.</p>	

PAYLOAD HAZARD REPORT CONTINUATION SHEET 2	a. NO: G-AMS-02-10
b. PAYLOAD: Alpha Magnetic Spectrometer-02 (AMS-02)	c. PHASE: 0/I
m. SAFETY VERIFICATION METHODS: <p>1.a. Proof tests will be performed on the GSE inner dewars at 45 psid ($> 1.5 \times \text{MAWP}$).</p> <p>1.b.1. Review of design analysis of LHe supply dewars pressure relief system to ensure proper pressure relief valve setting was determined and to ensure adequate vent capacity.</p> <p>1.b.2. QA verification on the relief valve settings.</p> <p>1.c. Proof tests will be performed on the TRD GSE pressure systems at $1.5 \times \text{MAWP}$.</p> <p>2.a.1. Analyses/tests are being performed to verify the burst disks provide sufficient flow rate to prevent exceeding the MDP of the flight dewar system. (See attached preliminary results of the AMS-02 flight dewar system ground emergency venting analysis.)</p> <p>2.a.2. Review of AMS-02 drawings showing burst disks and QA inspections of as-built hardware to approved drawings.</p> <p>2.b. Review of ground operations set-up design and procedures which specify that venting will be out of the work area.</p> <p>3. An analysis has been performed to determine the effect of a sharp pointed object (ice pick) falling and hitting the bare vacuum case in the thinnest section. The AMS-02 trunnions are currently located at $X_0=1163.4$ inches, with the top of the vacuum case at $X_0=1145$ inches. The Orbiter bulkhead is located at $X_0=581$ inches. This gives a maximum distance of 564 inches. The analysis shows positive margins of safety if a 0.25 lb. ice pick falls from the top of the payload bay and hits the thinnest point of the outer cylinder of the vacuum case.</p> <p>4.a. Review and approval of procedures.</p> <p>4.b. Review and approval of supply dewar safety training material, TRD GSE pressure systems and flight dewar procedures, and certification of personnel.</p> <p>4.c. Review and approval of procedures to restrict access.</p> <p>5.a. Certification of purity standards by test of delivered GHe included in procedures.</p> <p>5.b. Review of pressure relief design and drawings.</p> <p>5.c. Review of procedures which include the use of LHe filters to fill GSE supply dewars and on the line to fill the flight dewar from the GSE dewars.</p>	

PAYLOAD HAZARD REPORT CONTINUATION SHEET 3	a. NO: G-AMS-02-10
b. PAYLOAD: Alpha Magnetic Spectrometer-02 (AMS-02)	c. PHASE: 0/I
n. STATUS OF VERIFICATION: 1.a. Open 1.b.1. Open 1.b.2. Open 1.c. Open 2.a.1. Open 2.a.2. Open 2.b. Closed 3. Open 4.a. Open 4.b. Open 4.c. Open 5.a. Open 5.b. Open 5.c. Open	

Transition Radiation Detector (TRD) Ground Support Pressure Systems Component Matrix

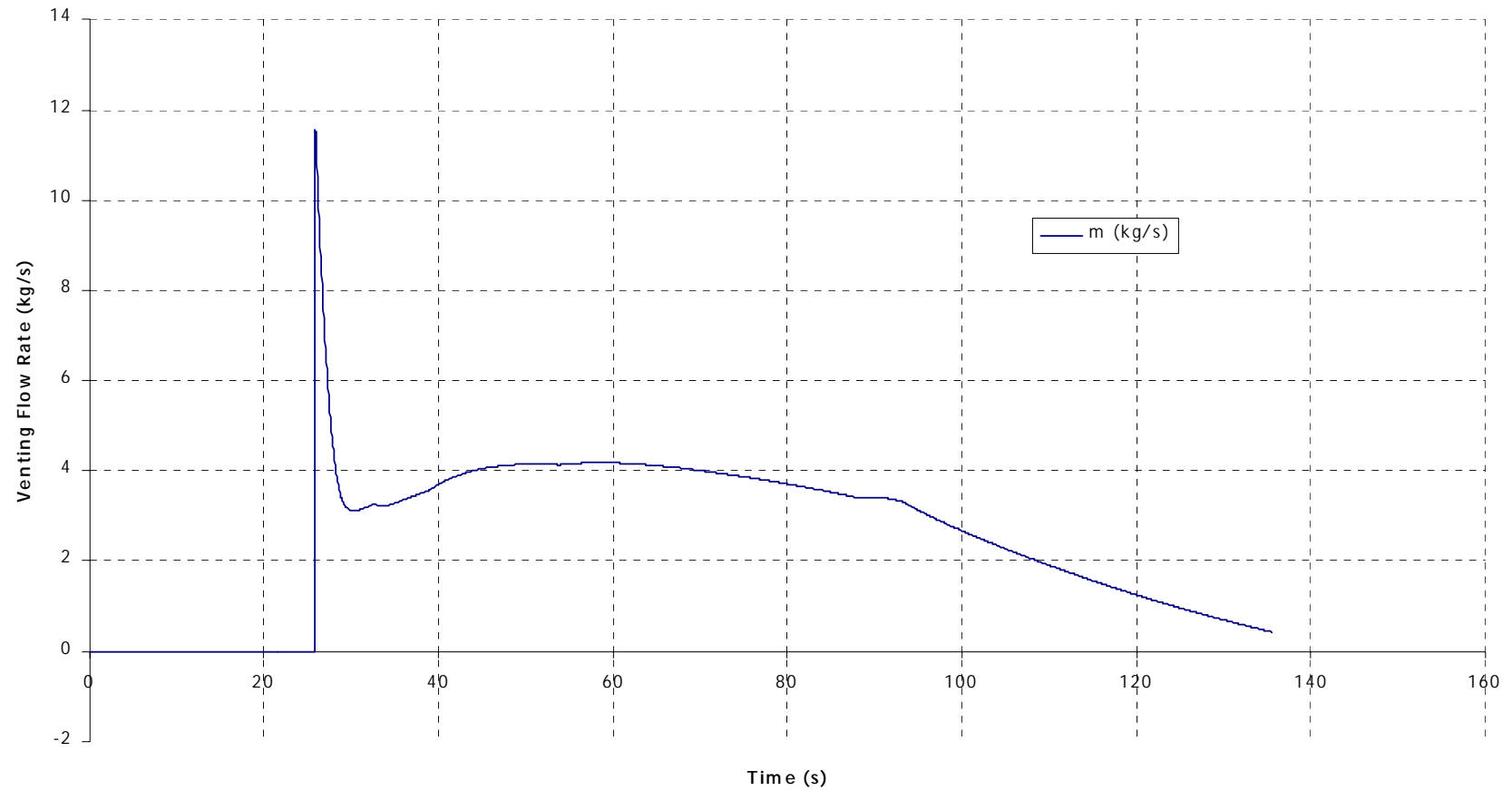
Date: 11/30/01

Component	Maximum Operating Pressure (MOP) (psia)	Design Maximum Allowable Working Pressure (MAWP) (psia)	Proof Pressure (psia)	Design Burst Pressure (psia)	Proof Test Date	Comments: (e.g. Gauge or Regulator Range, Relief Setting, etc.)
Box C¹:						
Self Sealing Fittings	140	200	300	560	Dec. 2002	TBD
Gas Purifier	140	200	300	560	Dec. 2002	Oxisorb MCTG-1001-XX Al container
Recovery System - High Pressure:						
Xe Storage	2200	3000	4500	8800	Dec. 2002	Two 3000 cu. in. stainless bottles
CO2 Storage	2200	3000	4500	8800	Dec. 2002	One 3000 cu. in. stainless bottle
Step-up Bottle	2200	3000	4500	8800	Dec. 2002	One 100 cu. in. stainless bottle
Valves/Fittings/Sensors	2200	3000	4500	8800	Dec. 2002	One meter stainless 6 mm. NUPRO Valves SS-DLV51 NUPRO SS-4R3A-K1-D Relief
Recovery System - Low Pressure²:						
Turbopump	<1	<1	N/A	N/A	N/A	Pfieffer TPD 020
Roughing Pump	14	14	N/A	N/A	N/A	Alcatel/Pascal/Franklin Electrical
Gas Analyzer	<1	<1	N/A	N/A	N/A	Amatek-Dycor LC200S
Sorption Pump	14	14	N/A	N/A	N/A	
Pressure Sensor	<1	<1	N/A	N/A	N/A	Varian F-2739301
Pressure Gauge	14	30	N/A	N/A	N/A	Ashcroft A4A-119343

NOTES: 1. The purifier connects to the Box C circuit via external, self-sealing fittings and will be removed before flight.

2. The recovery system must be evacuated before use and the low pressure part of the system is kept under continuous vacuum in order to maintain cleanliness. The system may be brought up to 1 atm. for maintenance.

AMS-02 Ground Emergency Venting Analysis
Total Loss of Vacuum with 3 mm Cryocoat



Note: Assumes complete loss of vacuum at $T = 0$.

PAYLOAD HAZARD REPORT		a. NO: G-AMS-02-11
b. PAYLOAD: Alpha Magnetic Spectrometer-02 (AMS-02)		c. PHASE: 0/I
d. SUBSYSTEM: Pressure	e. HAZARD GROUP: Explosion, Collision, Injury, Temperature Extremes	f. DATE: February 2002
g. HAZARD TITLE: Failure of GSE Servicing Lines		i. HAZARD CATEGORY <input checked="" type="checkbox"/> CATASTROPHIC <input type="checkbox"/> CRITICAL
h. APPLICABLE SAFETY REQUIREMENTS: KHB 1700.7C, Sections: 4.3.3 Pressure/Vacuum Systems and 4.3.8 Cryogenics		
j. DESCRIPTION OF HAZARD: Failure of GSE servicing lines could cause personnel injury and/or damage to STS/ISS equipment, payloads, GSE and/or KSC facilities.		
k. HAZARD CAUSES: 1. Bursting of GSE servicing lines due to inadequate design or construction. 2. Improper use of servicing lines or inadequate handling procedures. 3. Unsecured lines cause whipping.		
l. HAZARD CONTROLS: 1.a. All GSE servicing lines and fittings are being designed to have a design burst pressure of 4 x MOP. (See attached TRD Ground Support Pressure Systems Component Matrix; GSE Cryogenic Servicing Pressure System Components Matrix is TBS.) (See Continuation Sheet 1)		
m. SAFETY VERIFICATION METHODS: (See Continuation Sheet 1 & 2)		
n. STATUS OF VERIFICATION: (See Continuation Sheet 2)		
o. APPROVAL	PAYLOAD ORGANIZATION	SSP/ISS
PHASE I	ORIGINAL SIGNED BY JAMES R. BATES ON 2/12/02	ORIGINAL SIGNED BY JOHN C. DOLLBERG ON 3/27/02
PHASE II		
PHASE III		

PAYLOAD HAZARD REPORT CONTINUATION SHEET 1	a. NO: G-AMS-02-11
b. PAYLOAD: Alpha Magnetic Spectrometer-02 (AMS-02)	c. PHASE: O/I
<p>I. HAZARD CONTROLS:</p> <p>1.b. Gauges and pressure relief devices will be provided on servicing lines and will be sized to protect downstream equipment, including flight hardware: relief devices on GSE will be set at TBD; there will be adequate support for the relief devices and discharge plumbing such that there will not be a structural failure; all pressure gauges will be sized such that the operating pressure will be $\leq 75\%$ of full scale; and all pressure gauges will have pressure relief devices.</p> <p>1.c. GSE servicing lines will be designed such that pressures cannot be trapped in any part of the pressure system which can get cold, without passive bleed-down capability.</p> <p>1.d. All high pressure regulated lines will be designed to have adequate relief paths.</p> <p>2. Personnel will be trained and approved servicing line procedures will be used.</p> <p>3. All high pressure lines will be tied down at both ends and every 6 ft.</p>	
<p>m. SAFETY VERIFICATION METHODS:</p> <p>1.a.1. Review of design analysis to show that servicing lines have a design burst pressure of at least 4 x MOP.</p> <p>1.a.2. GSE cryogen system will be cold shock tested with LN₂.</p> <p>1.a.3. Proof pressure tests will be performed on all lines and fittings to at least 1.5 x MOP.</p> <p>1.b. Design review and payload organization certification that as-built hardware is in accordance with approved drawings and KHB 1700.7C requirements.</p> <p>1.c.1. Design review and payload organization certification that as-built hardware is in accordance with approved drawings and KHB 1700.7C requirements.</p> <p>1.c.2. Functional testing of pressure bleed-down system will be performed.</p> <p>1.d. Design review to ensure all high pressure lines have adequate relief paths.</p> <p>(See Continuation Sheet 2)</p>	

PAYLOAD HAZARD REPORT CONTINUATION SHEET 2		a. NO: G-AMS-02-11
b. PAYLOAD: Alpha Magnetic Spectrometer-02 (AMS-02)		c. PHASE: 0/I
m. SAFETY VERIFICATION METHODS: 2. Payload organization certification of training and approval of servicing line handling procedures. 3. Review of the procedures which specify the tie down of all high pressure lines at both ends and every 6 ft.		
n. STATUS OF VERIFICATION: 1.a.1. Open 1.a.2. Open 1.a.3. Open 1.b. Open 1.c.1. Open 1.c.2. Open 1.d. Open 2. Open 3. Open		

Transition Radiation Detector (TRD) Ground Support Pressure Systems Component Matrix

Date: 11/30/01

Component	Maximum Operating Pressure (MOP) (psia)	Design Maximum Allowable Working Pressure (MAWP) (psia)	Proof Pressure (psia)	Design Burst Pressure (psia)	Proof Test Date	Comments: (e.g. Gauge or Regulator Range, Relief Setting, etc.)
Box C¹:						
Self Sealing Fittings	140	200	300	560	Dec. 2002	TBD
Gas Purifier	140	200	300	560	Dec. 2002	Oxisorb MCTG-1001-XX Al container
Recovery System - High Pressure:						
Xe Storage	2200	3000	4500	8800	Dec. 2002	Two 3000 cu. in. stainless bottles
CO2 Storage	2200	3000	4500	8800	Dec. 2002	One 3000 cu. in. stainless bottle
Step-up Bottle	2200	3000	4500	8800	Dec. 2002	One 100 cu. in. stainless bottle
Valves/Fittings/Sensors	2200	3000	4500	8800	Dec. 2002	One meter stainless 6 mm. NUPRO Valves SS-DLV51 NUPRO SS-4R3A-K1-D Relief
Recovery System - Low Pressure²:						
Turbopump	<1	<1	N/A	N/A	N/A	Pfieffer TPD 020
Roughing Pump	14	14	N/A	N/A	N/A	Alcatel/Pascal/Franklin Electrical
Gas Analyzer	<1	<1	N/A	N/A	N/A	Amatek-Dycor LC200S
Sorption Pump	14	14	N/A	N/A	N/A	
Pressure Sensor	<1	<1	N/A	N/A	N/A	Varian F-2739301
Pressure Gauge	14	30	N/A	N/A	N/A	Ashcroft A4A-119343

NOTES: 1. The purifier connects to the Box C circuit via external, self-sealing fittings and will be removed before flight.

2. The recovery system must be evacuated before use and the low pressure part of the system is kept under continuous vacuum in order to maintain cleanliness. The system may be brought up to 1 atm. for maintenance.

PAYLOAD HAZARD REPORT		a. NO: G-AMS-02-12
b. PAYLOAD: Alpha Magnetic Spectrometer-02 (AMS-02)		c. PHASE: 0/I
d. SUBSYSTEM: Pressure, Human Factors	e. HAZARD GROUP: Injury/Illness, Temperature Extremes	f. DATE: February 2002
g. HAZARD TITLE: Exposure to High-Pressure Gas, Cold Helium (He)/Nitrogen (N ₂) Gas, Liquid Nitrogen (LN ₂) and/or Cold Surfaces		i. HAZARD CATEGORY <input type="checkbox"/> CATASTROPHIC <input checked="" type="checkbox"/> CRITICAL
h. APPLICABLE SAFETY REQUIREMENTS: KHB 1700.7C, Section: 4.2.1.5 Temperature		
j. DESCRIPTION OF HAZARD: Ground personnel could be injured if they come in contact with high-pressure gas, cold He/N ₂ gas, LN ₂ and/or cold surfaces.		
k. HAZARD CAUSES: 1. Exposure to high-pressure gas and/or cold He gas at vents or pressure relief devices on the AMS-02 payload, GSE He supply dewars or TRD GSE pressure systems due to equipment failure or operator error. 2. Exposure to cold He gas at AMS-02 payload or GSE supply dewar vents during normal fill/transfer operations. 3. Exposure to LN ₂ and/or cold N ₂ gas from the TRD Xenon (Xe) Handling Station dewar (which is partially open to the atmosphere).		
l. HAZARD CONTROLS: 1.a. Vents and relief devices (including emergency vent lines) will be directed out of the work area by proper GSE set-up design, or by use of vent shields and deflectors. (See Continuation Sheet 1)		
m. SAFETY VERIFICATION METHODS: (See Continuation Sheet 1)		
n. STATUS OF VERIFICATION: (See Continuation Sheet 2)		
o. APPROVAL	PAYLOAD ORGANIZATION	SSP/ISS
PHASE I	ORIGINAL SIGNED BY JAMES R. BATES ON 2/12/02	ORIGINAL SIGNED BY JOHN C. DOLLBERG ON 3/27/02
PHASE II		
PHASE III		

PAYLOAD HAZARD REPORT CONTINUATION SHEET 1	a. NO: G-AMS-02-12
b. PAYLOAD: Alpha Magnetic Spectrometer-02 (AMS-02)	c. PHASE: 0/I
<p>I. HAZARD CONTROLS:</p> <p>1.b. Labels clearly identifying vents and relief devices will be provided to warn personnel.</p> <p>2.a. Personnel will use appropriate protective clothing (e.g., face shield, gloves, apron, etc.) when using liquid He transfer equipment.</p> <p>2.b. Access to payload and GSE supply dewars will be limited during fill/transfer operations.</p> <p>2.c. Labels clearly identifying vents and cold surfaces will be provided to warn personnel to stay clear.</p> <p>2.d. Personnel training in liquid helium fill/transfer operations will be provided.</p> <p>3.a. A splash hood/vent arrangement is TBD to protect personnel from contact with LN₂ and to carry away the cold N₂ gas.</p> <p>3.b. Personnel will use appropriate protective clothing (e.g., face shield, gloves, apron, etc.) when using LN₂ equipment.</p> <p>3.c. Access to the Xe Handling Station dewar will be limited during fill/removal operations.</p> <p>3.d. Labels clearly identifying cold surfaces will be provided to warn personnel to stay clear.</p> <p>3.e. Personnel training in LN₂ fill/removal operations will be provided.</p>	
<p>m. SAFETY VERIFICATION METHODS:</p> <p>1.a. Procedures will specify that venting will be out of the work area.</p> <p>1.b. QA inspection of warning labels to verify they are located at each vent and pressure relief device.</p> <p>2.a. Procedures will specify the use of appropriate protective clothing.</p> <p>2.b. Procedures will specify establishing limited access areas.</p> <p>2.c. QA inspection of warning labels to verify they are located at each vent and on all cold surfaces.</p> <p>(See Continuation Sheet 2)</p>	

PAYLOAD HAZARD REPORT CONTINUATION SHEET 2		a. NO: G-AMS-02-12
b. PAYLOAD: Alpha Magnetic Spectrometer-02 (AMS-02)		c. PHASE: 0/I
m. SAFETY VERIFICATION METHODS: 2.d. Certification of personnel cryogen handling training. 3.a. Review of TRD Xe Handling Station drawings and QA inspections of as-built hardware to approved drawings. 3.b. Procedures will specify the use of appropriate protective clothing. 3.c. Procedures will specify establishing limited access areas. 3.d. QA inspection of warning labels to verify they are located on all cold surfaces. 3.e. Certification of personnel LN ₂ handling training.		
n. STATUS OF VERIFICATION: 1.a. Open 1.b. Open 2.a. Open 2.b. Open 2.c. Open 2.d. Open 3.a. Open 3.b. Open 3.c. Open 3.d. Open 3.e. Open		

PAYLOAD HAZARD REPORT		a. NO: G-AMS-02-13
b. PAYLOAD: Alpha Magnetic Spectrometer-02 (AMS-02)		c. PHASE: 0/I
d. SUBSYSTEM: Human Factors	e. HAZARD GROUP: Injury/Illness	f. DATE: March 2002
g. HAZARD TITLE: Loss of Breathable Atmosphere		i. HAZARD CATEGORY <input checked="" type="checkbox"/> CATASTROPHIC <input type="checkbox"/> CRITICAL
h. APPLICABLE SAFETY REQUIREMENTS: KHB 1700.7C, Section: 4.4.2.1.b. Oxygen Deficient Atmospheres and 4.4.4 Toxic Materials		
j. DESCRIPTION OF HAZARD: Exposure of personnel to Helium (He), Xenon (Xe), Carbon Dioxide (CO ₂), Ammonia (NH ₃) and/or Nitrogen (N ₂) atmosphere (displacement of oxygen) due to AMS-02 payload/GSE normal or abnormal venting rates and/or leakage, creating an asphyxiation/toxicity hazard.		
k. HAZARD CAUSES: 1. Accumulation of He, Xe, CO ₂ , NH ₃ or N ₂ gas in an enclosed space during normal or abnormal (due to equipment failure or operator error) venting or pressure relief operation. 2. Prolonged close proximity to an operating vent or pressure relief device causes personnel to suffer oxygen deprivation.		
l. HAZARD CONTROLS: 1.a. Adequate ventilation will be provided for all rooms or enclosed areas which the AMS-02 payload, GSE supply dewars (when containing He), Cryomag N ₂ /LN ₂ GSE and TRD Xe, CO ₂ and LN ₂ GSE will occupy. (NOTE: AMS-02 flight hardware emergency vent lines may have to be vented outside of KSC facilities to avoid oxygen deprivation. Also, venting of pumps will be external to the Payload Changeout Room.) (See Continuation Sheet 1)		
m. SAFETY VERIFICATION METHODS: (See Continuation Sheet 1)		
n. STATUS OF VERIFICATION: (See Continuation Sheet 1)		
o. APPROVAL	PAYLOAD ORGANIZATION	SSP/ISS
PHASE I	ORIGINAL SIGNED BY JAMES R. BATES ON 3/22/02	ORIGINAL SIGNED BY JOHN C. DOLLBERG ON 3/27/02
PHASE II		
PHASE III		

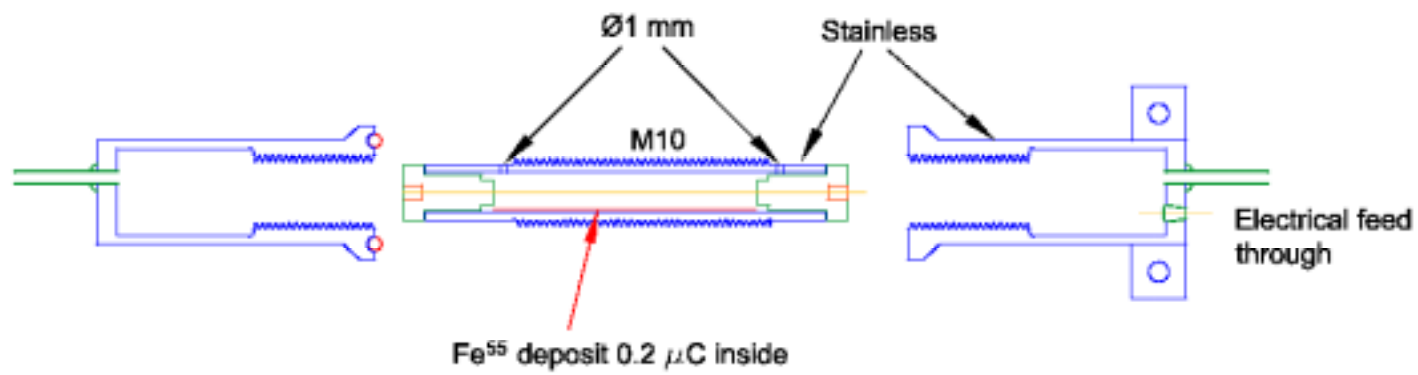
PAYLOAD HAZARD REPORT CONTINUATION SHEET 1	a. NO: G-AMS-02-13
b. PAYLOAD: Alpha Magnetic Spectrometer-02 (AMS-02)	c. PHASE: 0/I
<p>i. HAZARD CONTROLS:</p> <p>1.b. KSC-provided O₂ and NH₃ level monitoring and warning system(s) will be used when He, Xe, CO₂, NH₃ or N₂ is involved in confined payload or GSE operations, if O₂ displacement and/or NH₃ concentration analyses determine it is necessary.</p> <p>1.c. Personnel will be trained regarding evacuation procedures for the event of an O₂ or NH₃ level alarm sounding.</p> <p>1.d. The NH₃ will be sealed in small diameter, aluminum heat pipes of the Thermal Control System, and already installed on the AMS-02 payload, prior to arrival at KSC.</p> <p>2.a. Labels will be provided which clearly identify vent and pressure relief locations to warn personnel.</p> <p>2.b. Procedures will be provided which preclude operations with He, Xe, CO₂ or N₂ involving less than two operators (i.e., use "buddy" system), where necessary.</p>	
<p>m. SAFETY VERIFICATION METHODS:</p> <p>1.a. Analyses will be performed to verify that the ventilation/emergency vent capacity for all of the KSC rooms/enclosed areas maintains $\geq 19.5\%$ oxygen concentration by volume in the worst-case venting scenario, and NH₃ concentration cannot reach a hazardous level.</p> <p>1.b. Verification of O₂ and NH₃ level monitoring and warning system(s) inclusion in all handling and operating procedures involving He, Xe, CO₂, NH₃ or N₂, if necessary.</p> <p>1.c. Certification of personnel training on evacuation procedures.</p> <p>1.d. Measurement of NH₃ levels around heat pipes after the AMS-02 payload arrives at KSC.</p> <p>2.a. QA inspection of warning labels to verify they are located at each vent and pressure relief device.</p> <p>2.b. Review of procedures.</p>	
<p>n. STATUS OF VERIFICATION:</p> <p>1.a. Open</p> <p>1.b. Open</p> <p>1.c. Open</p> <p>1.d. Open</p> <p>2.a. Open</p> <p>2.b. Open</p>	

PAYLOAD HAZARD REPORT		a. NO: G-AMS-02-14
b. PAYLOAD: Alpha Magnetic Spectrometer-02 (AMS-02)		c. PHASE: 0/I
d. SUBSYSTEM: Mechanical, Human Factors	e. HAZARD GROUP: Collision, Injury	f. DATE: February 2002
g. HAZARD TITLE: Inadvertent Tipping, Sliding or Rolling of AMS-02 GSE/GHE		i. HAZARD CATEGORY <input checked="" type="checkbox"/> CATASTROPHIC <input type="checkbox"/> CRITICAL
h. APPLICABLE SAFETY REQUIREMENTS: KHB 1700.7C, Sections: 4.2.1.4.f. Physical		
j. DESCRIPTION OF HAZARD: AMS-02 GSE supply dewars, GSE racks or GHE carts could inadvertently tip, slide or roll and impact personnel, STS/ISS equipment, payloads, GSE and/or KSC facilities resulting in injury and/or damage.		
k. HAZARD CAUSES: 1. Inadequate design to prevent inadvertent movement. 2. Personnel error.		
l. HAZARD CONTROLS: 1.a. AMS-02 GSE/GHE will be designed with a low enough center-of-gravity to preclude inadvertent tipping or sliding. 1.b. AMS-02 GSE/GHE with wheels, castors, etc., will be equipped with locking features to prevent inadvertent rolling. 2. Approved procedures will be used for transporting and securing AMS-02 GSE/GHE.		
m. SAFETY VERIFICATION METHODS: 1.a. Center-of-gravity analyses will be performed for AMS-02 GSE supply dewars, GSE racks and GHE carts. (See Continuation Sheet 1)		
n. STATUS OF VERIFICATION: (See Continuation Sheet 1)		
o. APPROVAL	PAYLOAD ORGANIZATION	SSP/ISS
PHASE I	ORIGINAL SIGNED BY JAMES R. BATES ON 2/12/02	ORIGINAL SIGNED BY JOHN C. DOLLBERG ON 3/27/02
PHASE II		
PHASE III		

PAYLOAD HAZARD REPORT CONTINUATION SHEET 1	a. NO: G-AMS-02-14
b. PAYLOAD: Alpha Magnetic Spectrometer-02 (AMS-02)	c. PHASE: 0/I
m. SAFETY VERIFICATION METHODS: 1.b. Review of AMS-02 drawings for wheel/castor locking features and QA inspections of as-built hardware to approved drawings. 2. Review and approval of AMS-02 transporting/securing procedures.	
n. STATUS OF VERIFICATION: 1.a. Open 1.b. Open 2. Open	

PAYLOAD HAZARD REPORT		a. NO: G-AMS-02-15
b. PAYLOAD: Alpha Magnetic Spectrometer-02 (AMS-02)		c. PHASE: 0/I
d. SUBSYSTEM: Radiation	e. HAZARD GROUP: Radiation, Injury and Illness	f. DATE: February 2002
g. HAZARD TITLE: Excessive Ionizing Radiation		i. HAZARD CATEGORY <input type="checkbox"/> CATASTROPHIC <input checked="" type="checkbox"/> CRITICAL
h. APPLICABLE SAFETY REQUIREMENTS: KHB 1700.7C, Section: 4.3.4 Radiation; and the American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices, dated 1995-1996.		
j. DESCRIPTION OF HAZARD: Ground personnel injury/illness due to exposure to the Transition Radiation Detector (TRD) ionizing radiation sources in the 4 calibration tubes mounted in Box C. Each calibration tube has a 0.2 microCurie deposit of Fe ₅₅ on the inner wall. (See attached figure of a calibration tube)		
k. HAZARD CAUSES: Inadequate containment of the ionizing radiation sources.		
l. HAZARD CONTROLS: 1. The 0.04 inch (1 mm) thick wall of the tube attenuates the 5.9 keV radiation to a level that is less than detectable. Each tube is mounted inside a stainless steel container. Each container is located in Box C. 2. The calibration tubes have been designed to prohibit the release or displacement of the ionizing radiation sources.		
m. SAFETY VERIFICATION METHODS: (See Continuation Sheet 1)		
n. STATUS OF VERIFICATION: (See Continuation Sheet 1)		
o. APPROVAL	PAYLOAD ORGANIZATION	SSP/ISS
PHASE I	ORIGINAL SIGNED BY JAMES R. BATES ON 2/12/02	ORIGINAL SIGNED BY JOHN C. DOLLBERG ON 3/27/02
PHASE II		
PHASE III		

PAYLOAD HAZARD REPORT CONTINUATION SHEET 1	a. NO: G-AMS-02-15
b. PAYLOAD: Alpha Magnetic Spectrometer-02 (AMS-02)	c. PHASE: 0/I
m. SAFETY VERIFICATION METHODS: 1.a. & 2.a. Review of TRD drawings and QA inspections of as-built hardware to approved drawings. 1.b. Measurement check of the radiation level on the outside of each flight calibration tube after final sealing in the stainless steel container and prior to mounting in the TRD Box C. 1.c. & 2.b. KSC Health Physics will perform a measurement check as soon as possible after arrival of the AMS-02 hardware containing the TRD calibration tubes. 1.d. & 2.c. Approval of KSC Form 16-295, "Radiation Use Request/Authorization (Radioactive Materials)", and KSC Forms 16-294, "Radiation Training and Experience Summary (Ionizing Radiation)", by KSC Health Physics and the KSC Radiation Protection Officer.	
n. STATUS OF VERIFICATION: 1.a. & 2.a. Open 1.b. Open 1.c. & 2.b. Open 1.d. & 2.c. Open	



Calibration Tube with Doubly Contained Weak Source

